DOCUMENT RESUME

ED 176 882 EC 120 530

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TITLE Intellectual Acceleration in Normal and Down's Syndrome Children Through Infant Stimulation and Language Training.
INSTITUTION Florida State Mental Health Inst., Tampa.
NOTE 19p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Downs Syndrome; Exceptional Child Research; *Infants; *Intellectual Development; *Intelligence; Interpersonal Competence; Mentally Handicapped; Operant Conditioning; Parent Participation; Psychomotor Skills; Self Care Skills; Speech Skills

ABSTRACT

The effects of stimulation and language training on the intellectual acceleration of seven normal and Down's Syndrome infants were studied. Intervention consisted of the operant conditioning of linguistic, social, self-help, and motor skills, and the training of parents in child management and child development topics. Among other things, it was found that, by the age of 1 year, all Ss were between two and three standard deviations above the expected mean IQ scores for their respective reference groups. The continued acceleration of intellectual development was demonstrated in all Ss by increasing IQ scores in the first year while in treatment, and through a full year of followup for the normal Ss. (DLS)

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INTELLECTUAL ACCELERATION IN NORMAL AND DOWN'S SYNDROME CHILDREN THROUGH INFANT STIMULATION AND LANGUAGE TRAINING

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INTRODUCTION

Intellectual development is said to be a non-additive interaction between heredity and environment (Anastasi, 1958). And the influence of genetics, Anasasi argues, is always indirect. Heredity factors set the extreme limits for intellectual ability while environment determines the attained level within the genetically-determined range.

The application of this principal might provide a foundation on which to build a preventatively-oriented intellectual development program. Data also exists which suggests that the prognosis for the amelioration of linguistic and intellectual deficits in children becomes increasingly bleak as the child passes the age of three (Drash and Liebowitz, 1973). It appears, then, that an effective infant stimulation program must, at least, provide a maximally stimulating environment as early as possible.

The goals of this pilot study are to:

1. Evaluate the effectiveness of Anastasi's hypotheses on intellectual development as an applied model for intervention, and to
2. Identify significant areas in infant development which may be influenced by such teaching strategies.

METHODS

SUBJECTS:

Subjects were two groups of Caucasion infants and their mothers. All parents were married at the time of involvement with the program (see Table 1). The first group was comprised of four infants whose pre-natal and post-natal medical histories were unremarkable. The second group of infants was composed of three infants whose medical condition was diagnosed as Down's Syndrome (Tri-Somy 21). Three of the normal infants were six months of age at admission, the fourth was three months. Two Down's infants were two months at age of admission, and one was six months old.

Duration of treatment was between five and seven months for the normals and between eleven and thirty-five months for the Down's infants.

MEASURES:

INTELLECTUAL DEVELOPMENT: Intellectual development was assessed by the Cattell Test of Infant Intelligence and the Stanford-Binet Test of Intelligence. The Cattell was used for children younger than two years and for the Down's Infants. The Stanford-Binet was used for normals older than two years.

SPEECH DEVELOPMENT: The normal infants' speech functioning was assessed at the one-year follow-up by the attained developmental level as articulated by Drash and Liebowitz (1973). The Peabody Picture Vocabulary Test was used to assess language development for this group at the two-year follow-up.

SOCIAL DEVELOPMENT: The Vineland Test of Social Maturity was used to evaluate the infants' rate of social development. An analysis of the items on the Vineland indicated that this assessment tool primarily measures self-help skills. The Behar Preschool Behavior Questionnaire was used to evaluate those social skills required in interpersonal interactions.

PROCEDURES: The group treatment program for the normal infants consisted of parent-training and child observation sessions which met, initially, on a weekly basis. The schedule was changed to alternating weeks and then to monthly meetings after about the second and fourth months of the program, respectively. The regular three-hour format of the program included the mothers' review and demonstration of observed changes in their child's motor, intellectual and linguistic behaviors, the staff's modeling of behavioral and stimulation procedures, lectures and discussions on aspects of infant development, and supervised peer-play for the infants.

Down's infants and their parents received individual training on either a once-weekly or alternating week basis. The treatment program emphasized the

acquisition of expressive and receptive language skills, the shaping of appropriate motor and self-help skills and parent training in infant stimulation and child management procedures.

RESULTS

Intelligence tests administered prior to discharge from the treatment program indicated that all normal infants were functioning within the superior range on the Binet or Cattell (See Table 2). Scores ranged from 123 to 143 with a mean of 136. One-year follow-up scores from this group revealed that this early strength endured and increased through the year following treatment. All infants scored at the superior level with IQ's ranging from 135 to 154 with a mean of 145 at the recent one-year follow-up testing session. The two-year follow-up for this group showed a continued upward trend in intellectual development for the normals. Scores ranged from 141 to 170 with a mean of 157.

Down's infants' IQ's at the time of admission ranged from 77 to 85 with a mean of 80.6. The IQ range of the one-year follow-up show a general upward trend. I.Q. scores ranged from 78 to 96 with a mean of 88.8. IQ scores for the oldest infant show continued intellectual improvement with an IQ of 99 at twenty-six months and 96 at thirty-two months.

Speech was judged to be at least one year above age level in three normal infants and at the expected age level for the fourth normal infant at the one-year follow-up (See Table 3). The linguistic repertories of the three advanced children were between 500 and 700 words at twenty-five months. This included the regular use of 3 to 10 word sentences. Mean language "quotients" for all subjects were at the superior level varying from 100 to 176 with a mean of 149. Language development at the two-year follow-up (chronological age 36 months) showed all three infants on whom data was available to be at least thirty months ahead of the expected level of performance. Mean language quotients were at the superior level, again, ranging from 127 to 138 with a mean of 134.

Self-help skills, as assessed by the Vineland were judged to be at the superior level for all normal infants at the one-year follow-up (See Table 4). Social quotients were from 128 to 192 with a mean of 169. Scores at the two-year follow-up showed continued improvement with social quotients ranging from 145 to 256 with a mean of 207 and an average social age of 88 months.

Socres on the Behar indicated that, at the one-year follow-up, all normal infants were functioning at average levels on most scales (See Table 5). Total disturbed behavior and hyperactive and distractible behaviors were within normal limits on all cases. Hostile and aggressive behaviors strayed form normal in two cases. Those children were at the eightieth and eighty-fifth percentiles. Anxious behaviors were within normal limits in three cases. One child was at the nintieth percentile. At the two-year follow-up, all factor scores dropped from the previous year's statistics. In all but four cases, every score was at or below the norm of 50. Mean factor scores were within normal limits.

DISCUSSION:

The results of this pilot investigation were consistent with those of previous studies (Gordon and Guinangh, 1974; Gordon, 1974). Training new parents in behavior modification procedures and in child development principles and shaping language, social and motor skills enhanced the infants' intellectual and social growth (See Graph 1). The level of intellectual development for normal infants appears to have continued to increase over the two years following treatment. All normal infants were functioning substantially above the expected level for their age. All Down's Syndrome Infants appear to be developing in a rate which is far above the expectation for Down's infants. Reports in the literature (Fishler,1975) indicate an expected I.Q. of 60 to 70 at one-year, followed by a decelerated rate of growth after the first year. IQs tend to plateau at the

third year at an expected quotient of 40 to 50. Three year IQ scores for the one child on whom data are available indicate that this deterioration in performance has not occurred. Minimally, data may suggest that the ultimate level of performance achieved by a Downs' Syndrome infant may be enhanced from such an intensive program.

Anastasi's hypothesis appears to be a sound principle on which to base preventative, intellectual development efforts. Data supports the statement that environment determines the achieved level of intellecutal growth within a broader, genetically-determined range. All children displayed trends in intellectual development far above what is normal for their reference group regardless of the genetic background of that child. Genetics did, as predicted, limit the upper level of intellectual achievement.

Information on developmental areas amenable to this sort of teaching program was perhaps the most valuable result of this preliminary investigation. Training procedures, including the demonstration of behavior control techniques, the operant conditioning of speech, and motor and problem solving exercises, and indicated five primary areas for future investigation. The were:

1. intellectual skills,
2. motor skills,
3. expressive and receptive speech,
4. social skills, both self-help and interpersonal, and
5. compliance with verbal commands.

Of particular interest were anecdotal reports which indicate that compliance first became a problem at approximatly seven months. At this time, the child first learned a means of self-locomotion. Subsequent problems with non-compliance were reportedly averted by the early identificationof one parent as an effective disciplinarian.

The aforementioned project differed from the traditional infant stimulation programs found in the literature (Gordon, 1974; Gordon and Guinaugh, 1974). The current program employed the parent as an intervention agent, particularly with the normal infants, and focused on teaching that person behavior modification procedures and important child development principles. Programs such as Gordon's (1974) involve stimulation of the child by the staff.

A recent report by the American Association for the Advancement of Science (1977) stated that increments in IQ and academic performance gained by participation in projects such as Head Start were more durable when parents were integral components of the intervention program. Attention to parent behaviors which was provided by this prevention strategy appears to have yielded more long-lasting and significant gains than do those intervention programs which focus on exclusive contact with the child.

In the case of the normal infants, IQs increased consistently in the two years following treatment. These continued gains might appropriatly be attributed to some training efforts by the parent.

A possible reason for the observed durable successes is that the attitude of the parents about child-rearing have been permanently altered. They appear to have taken an active invovlement in determining the course of their children's development. One mother reported understanding that language does not "just occur" it must be actively taught. Repeated successes with their children, having specific intervention, possibly resulting from knowing specific procedures available to her, may have made contact with the child a highly reinforcing event. It follows that the reinforcing value of the interaction has increased the liklihood that the parent will engage in future training efforts with the child.

Results of this project are inconclusive due to the lack of adequate control and/or time-series assessments. However, potentially valuable paths for further study in the area of prevention of mental disorders, particularly intellectual dysfunction, were highlighted by this pilot effort.

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TABLE I

SUBJECTS

INITIALS	GROUP	SEX	D.O.B.	INITIAL CHRONOLOGICAL AGE IN MONTHS	MONTHS IN PROGRAM
1. N.W.	Normal	F	3/12/75	6	7
2. R.T.	Normal	M	3/19/75	5	7
3. K.L.	Normal	F	3/22/75	5	7
4. V.T.	Normal	F	8/19/75	3	5
5. K.K.	Down's	F	7/29/77	2	18
6. M.A.	Down's	M	10/22/77	6	11
7. L.B.	Down's	F	2/15/76	2	35

TABLE 2

INTELLECTUAL DEVELOPMENT

NORMAL INFANTS

INITIALS	SEX	CATTELL I.Q. UPON DISCHARGE/ADMISSION	BINET I.Q. AT ONE-YEAR FOLLOW-UP (approx chronological age 2 years)	BINET I.Q. AT TWO-YEAR FOLLOW-UP
1. N.W.	F (Normal)	136 (16.4)/(12.0) (Disc.)	154 ** (42.0)/(25.0)	141 (64.0)/(44.0)
2. R.T.	M (Normal)	135 (16.3)/(12.0) (Disc.)	135 (33.0)/(23.0)	170 (80.0)/(43.0)
3. K.L.	F (Normal)	123 (14.8)/(12.0) (Disc.)	150 ** (41.0)/(25.0)	———
4. V.T.	F (Normal)	143 (10.0)/(7.0) (Disc.)	142 * (28.4)/(20.0)	160 (69.0)/(41.0)
5. K.K.	F (Down's)	80 (2.4)/(3.0) (Adm.)	78 * (9.4)/(12.0)	
6. M.A.	M (Down's)	77 (5.4)/(7.0) (Adm.)	92 * (10.6)/(12.0)	
7. L.B.	F (Down's)	85 (3.4)/(4.0) (Adm.)	96 * (11.5)/(12.0)	
Mean (Normals)		136	145	157
Mean (Down's)		80.6	88.8	

* Cattell
** Obtained through Parent Report

TABLE 3

SPEECH DEVELOPMENT AT FOLLOW-UP

INITIALS	SEX	ONE-YEAR FOLLOW-UP*				TWO-YEAR FOLLOW-UP**	
		SPEECH LEVEL	EXPRESSIVE SPEECH	LANGUAGE AGE (in months)	LANGUAGE QUOTIENT	LANGUAGE AGE (in months)	LANGUAGE QUOTIENT
1. N.W.	F	19	6-7 word sentences 700 words	44	176	80	138
2. R.T.	M	16	3-4 word sentences 500 words	36	144	80	138
3. K.L.	F	19	6-10 word sentences 700 words	44	176	_____	
4. V.T.	F	10	1 word sentences 100 words	20	100	66	127

*Based on Speech Development norms in Drash & Leibowitz (1973)

**Based on PPVT scores.

TABLE 4

VINELAND SOCIAL DEVELOPMENT - (AT FOLLOW-UP)

INITIALS	SEX	ONE-YEAR FOLLOW-UP		TWO-YEAR FOLLOW-UP	
		SOCIAL QUOTIENT	SOCIAL AGE (in months)	SOCIAL QUOTIENT	SOCIAL AGE (in months)
1. N.W.	F	128	32	145	64
2. R.T.	M	192	48	223	94
3. K.L.	F	192	48	196	90
4. V.T.	F	165	33	256	105
Mean:		169	40.3	207	88.25

TABLE 5

PSYCHOLOGICAL DEVELOPMENT AT FOLLOW-UP
Percentile Rank on the
(Behar Preschool Behavior Questionnaire)

		ONE-YEAR FOLLOW-UP				TWO-YEAR FOLLOW-UP			
INITIALS	SEX	TOTAL: DISTURBED BEHAVIOR	SCALE 1 HOSTILE-AGGRESSIVE	SCALE 2 ANXIOUS	SCALE 3 HYPERACTIVE DISTRACTIBLE	TOTAL: DISTURBED BEHAVIOR	SCALE 1 HOSTILE-AGGRESSIVE	SCALE 2 ANXIOUS	SCALE 3 HYPERACTIVE DISTRACTIBLE
1. N.W.	F	65	80	65	50	35	70	48	48
2. R.T.	M	25	50	50	50	30	50	48	48
3. K.L.	F	65	85	65	30	25	65	48	30
4. V.T.	F	65	65	90	65	52	67	90	30
Mean:		55	70	67.5	43.8	35.5	63.0	58.5	39.0

INTELLECTUAL DEVELOPMENT OF NORMAL
AND DOWN'S SYNDROME INFANTS